BRIEF PALAEONTOLOGICAL IMPACT ASSESSMENT

PROPOSED SAND MINE ON BLAAUWBERG FARM (CAPE FARM 88 AND CAPE FARM 91), NEAR MELKBOSSTRAND, CITY OF CAPE TOWN, WESTERN CAPE

By
John Pether, M.Sc., Pr. Sci. Nat. (Earth Sci.)
Geological and Palaeontological Consultant
P. O. Box 48318, Kommetjie, 7976
Tel./Fax (021) 7833023
Cellphone 083 744 6295
jpether@iafrica.com

Prepared at the Request of

AMATHEMBA Environmental Management Consulting
PO Box 46
DARLING,7345
Cell: 082 782 3727
Fax: 086 671 9841
E-mail: sdavey@mweb.co.za

For

Tip Trans Resources (Pty) Ltd

22 February 2012

HWC Case No. 111019JB16. ID 1619 - 1604
DEA&DP Reference: E12/2/4/2-A2/305-3031/11

CONTENTS

SUMMARY

Tip Trans Resources (Pty) Ltd proposes to mine sand and is applying for a mining right on the property known as Blaauwberg Farm situated east of Melkbosstrand (Figure 1). AMATHEMBA Environmental Management Consulting cc (AMATHEMBA) has been appointed by Tip Trans Resources to undertake the application for environmental authorisation for the proposed project. The thickness to be mined is ~2 m and after mining the topsoil will be stockpiled and replaced and rehabilitated to pasture.

The proposed mining areas are situated on the **Springfontyn Formation** (Figure 2). The Springfontyn Formation is an informal category that accommodates the mainly non-calcareous, windblown sand sheets and dunes that have covered parts of the landscape during the middle and late Quaternary. White sands of the Holocene Witzands Formation have encroached upon the area in the southeast (MA4 & MA5). The investigation of the thickness of sand in the mining areas by trial pitting (Lanz, 2011) shows that it is usually less than ~3 m, but this is exceeded locally by higher Witzand dune forms.

Some fossil bones of terrestrial mammals have been found in the Springfontyn Formation and lignified and “coalified” plants, tree stumps and logs have been found at several places and are the most common fossil remains encountered (Theron, 1984). Notwithstanding, the fossil potential of the Springfontyn Formation is low. The Springfontyn Formation may be underlain by marine deposits such as residual basal gravels with abraded fossil bones and teeth. There is some possibility of encountering residual marine deposits below ~50 m asl. in areas MA1 and MA2. However, these are likely to be decalcified and altered.

In view of the low fossil potential it is proposed that only a basic degree of mitigation is required. It is recommended that an alert for the uncovering of fossil bone and implements be included in the EMP for the mine.

Appendices 1 and 2 outline monitoring by construction personnel and general Fossil Find Procedures. This is a general guideline, to be adapted to circumstances.

In the event of possible fossil and/or archaeological finds, the contracted archaeologist or palaeontologist must be contacted. For possible fossil finds, the palaeontologist will assess the information and liaise with the developer and the ECO and a suitable response will be established.

---oooOOOooo---

The author, John Pether, is an independent consultant/researcher and is a recognized authority in the field of coastal-plain and continental-shelf palaeoenvironments and is consulted by exploration and mining companies, by the Council for Geoscience, the Geological Survey of Namibia and by colleagues/students in academia pursuing coastal-plain/shelf projects.

Expertise

- Shallow marine sedimentology.
- Coastal plain and shelf stratigraphy (interpretation of open-pit exposures and on/offshore cores).
- Marine macrofossil taxonomy (molluscs, barnacles, brachiopods).
- Marine macrofossil taphonomy.
- Sedimentological and palaeontological field techniques in open-cast mines (including finding and excavation of vertebrate fossils (bones).
- Analysis of the shelly macrofauna of modern samples e.g. for environmental surveys.

Membership Of Professional Bodies

- South African Council of Natural Scientific Professions. Earth Science. Reg. No. 400094/95.
- Geological Society of South Africa.
- Palaeontological Society of Southern Africa.
- Southern African Society for Quaternary Research.
- Heritage Western Cape. Member, Permit Committee for Archaeology, Palaeontology and Meteorites.
- Accredited member, Association of Professional Heritage Practitioners, Western Cape.

---oooOOOooo---

1 INTRODUCTION

Tip Trans Resources (Pty) Ltd proposes to mine sand and is applying for a mining right on the property known as Blaauwberg Farm, specifically on parts of the Remaining Extent of Cape Farm No.88 and Cape Farm No. 91, situated east of Melkbosstrand (Figure 1). AMATHEMBA Environmental Management Consulting cc (AMATHEMBA) has been appointed by Tip Trans Resources to undertake the application for environmental authorisation for the proposed project. The relevant authority is the Western Cape Department of Environmental Affairs & Development Planning (DEA&DP).

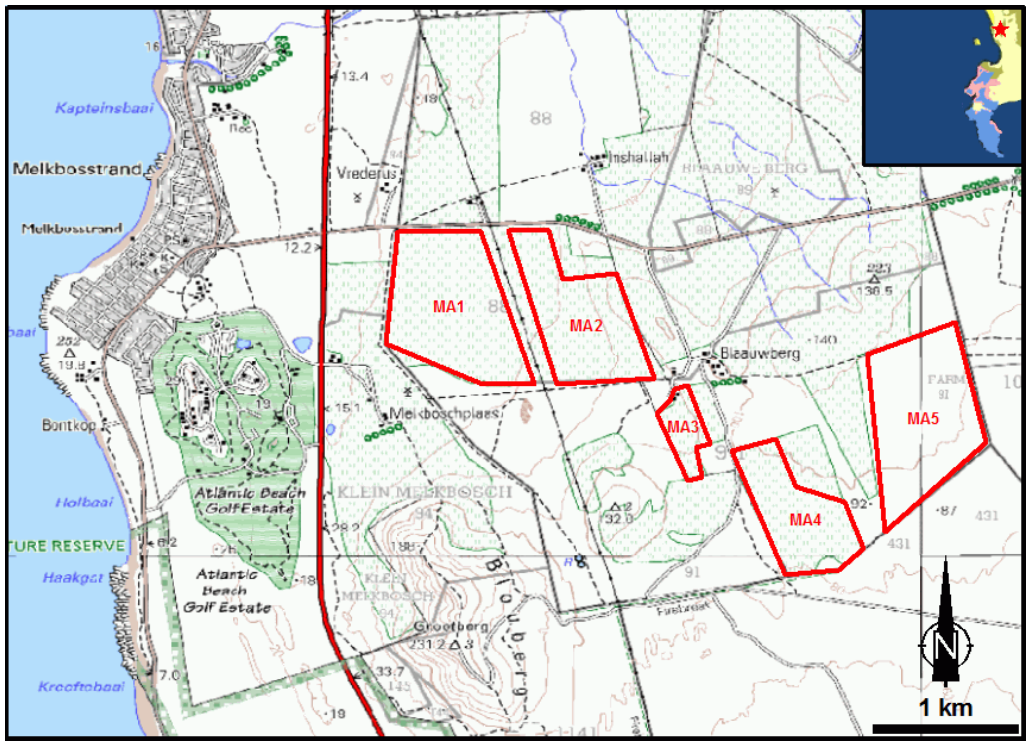


Figure 1. Proposed mining areas for the sand mining right application on Blaauwberg Farm. Extracted from 1:50000 topo-cadastral maps - Chief Directorate: Surveys & Mapping.

The land is owned by Joyces Dairy Farm (Pty) Ltd. and has been ploughed and used as pasture land for cattle. The mining application involves ~336 hectares in 5 separate proposed mining areas (Figure 1).

The planned mining sequence is as follows:

- Overburden clearing and stockpiling of topsoil of a 1 hectare sized mining block using a bulldozer or a Front End Loader;
- Excavation of sand using an Excavator;
- Loading of material into trucks using an Excavator;
- Reshaping the excavation sides, replacing top soil, stabilising the soil surface and re-vegetating with pasture crops.

The main purposes of this palaeontological assessment are to:

- Outline the nature of possible palaeontological/fossil heritage resources in the subsurface of the project area.

- Suggest the mitigatory actions to be taken with respect to the occurrence of fossils during mining.

Palaeontological interventions mainly happen once fossil material is exposed at depth, *i.e*. once the EIA process is done and mining commences. The action plans and protocols for palaeontological mitigation must therefore be *included in the Environmental Management Plan (EMP)* for the sand mine.

Included herein is a general fossil-finds procedure for the appropriate responses to the discovery of paleontological materials during sand mining.

2 GEOLOGICAL SETTING

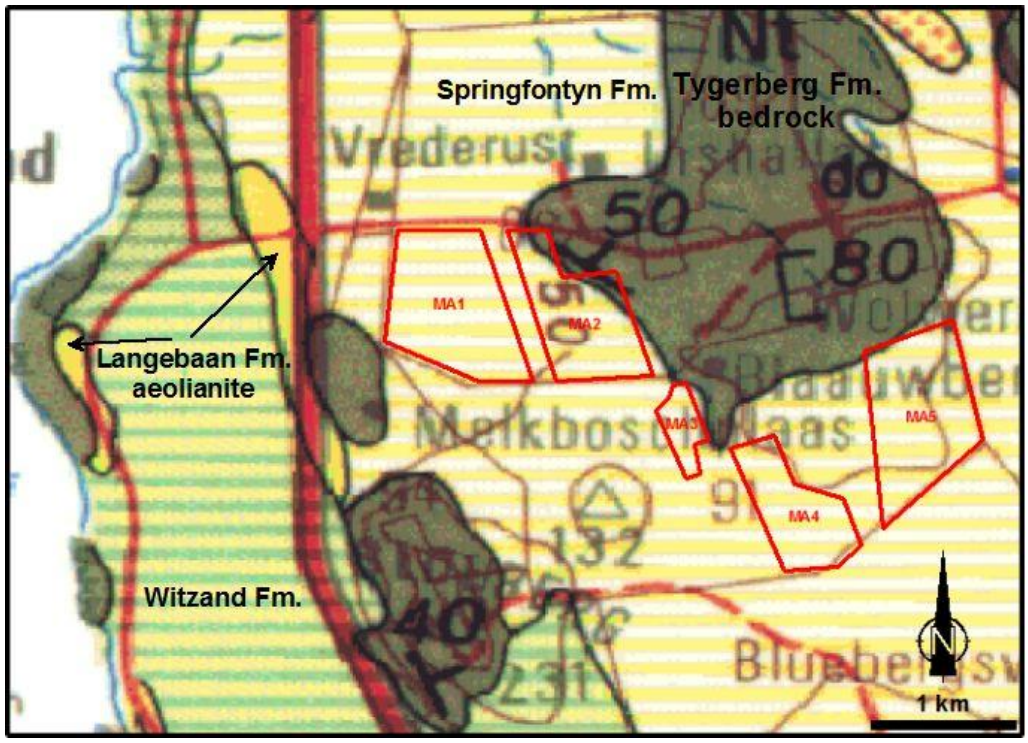


Figure 2. Geology of the project area. Extract of 1:250 000 Geological Series map, Sheet 3318 Cape Town. 1990. Council for Geoscience, Pretoria.

Across MA1 and part of MA2, the coastal plain rises gently inland from ~23 m asl. to ~45 m asl. Thereafter it steepens up to ~80 m asl., on the flank of a low hill. MA3 is situated on the flank of the hill between ~75-90 m asl. Ma 4 and MA5 are on a gentle south-facing slope between ~80 to 110 m asl.

The coastal-plain bedrock that forms the hills of the area are composed of weathered shale of the **Tygerberg Formation** (Malmesbury Group): highly deformed and metamorphosed deep-sea turbidites that are ~600 Ma (Mega-annum - million years old), It has no intrinsic palaeontological potential.

The coastal plain has been inundated by the sea at various times. During the global warming of the Mid-Miocene Climatic Optimum ~16 Ma , enough of the Antarctic ice cap had melted to raise sea level to the extent that the coastal plain was submerged as a shallow sea. This ancient shoreline is now uplifted to ~100 m asl. and in places along the West Coast is marked by marine gravels occurring seaward of a prominent slope "nick" or even vertical "fossil" sea cliffs. However, to the writer's knowledge, *in situ* mid-Miocene marine deposits at high elevations have not been exposed or recognized in this area. Notwithstanding, phosphatic, ostensibly marine deposits are recognized in boreholes and just to the north of Elandsfontein extend to 90 m asl. (borehole S22, Rogers, 1980). Should the age of these deposits indeed prove to mid-Miocene, precedence dictates that it is named the **Saldanha Formation.**

At lower elevations further seaward, marine deposits of Pliocene age drape the bedrock and older sediments on the coastal plain. These include two formations, *viz*. the early Pliocene **Varswater Formation** and the mid-Pliocene "**Uyekraal Formation**". The type area of the former is the exposures at the West Coast Fossil Park where the fossils from the upper part show that the age of the deposits is about 5 Ma and that the origin of the deposits is related to the early Pliocene sea level high that reached 50-60 m asl. Sea level rose again in the middle Pliocene (~3.0 Ma) to a level now ~30 m asl. The associated marine deposits underlie the flat plain extending west from the West Coast Fossil Park. Rogers (1983) named the marine deposits the Uyekraal Shelly Sand Member of the Bredasdorp Formation. Note that the Uyekraal Shelly Sand Member is not formally recognized and is subsumed in the Varswater Formation, but it is deserving of being called the "Uyekraal Formation", Sandveld Group.

To the west of the area are outcrops of calcareous aeolianites (old dune sands) and calcretes ("surface limestones") of the **Langebaan Formation** (Figure 2), of late Quaternary age. These locally-fossiliferous old dunes do not occur in the area of interest.

The latest addition of dunes to the coastal plain is the **Witzand Formation** (Figure 2). These are sands blown from the beach in the last few thousand years and added to the fossil dune cordon or "sand wall" parallel to the coast, or have blown further as dune plumes transgressing a few kilometres inland.

The proposed mining areas are situated on the **Springfontyn Formation** (Figure 2). The Springfontyn Formation is an informal category that accommodates the mainly non-calcareous, windblown sand sheets and dunes that have covered parts of the landscape during the Quaternary. In the Saldanha area, Visser & Schoch (1972, 1973) differentiate the coversands by their surface appearance into 2 surficial units, Q2 (older cover) and Q1 (younger cover). The Springfontyn Fm. consists of the sequences beneath these "coversands", *i.e*. SubQ2 and SubQ1. This formation comprises quartzose (silica) sands representing mainly decalcified aeolian deposits. It includes very leached "glass sands" such as in the Philippi area. In places the sand is variously stained by Fe-oxides, with orange to reddish-brown hues. Locally these deposits may include muddy sands, possibly of marine/lagoonal origin, and peaty sands formed in marshy or vlei environments (Rogers, 1980). Thin clay layers occur, lenses of peat are common and can be

significant deposits up to 6 m thick (Theron, 1984). These are usually in the lower part of the sequence and related to topographic lows in the underlying palaeosurface.

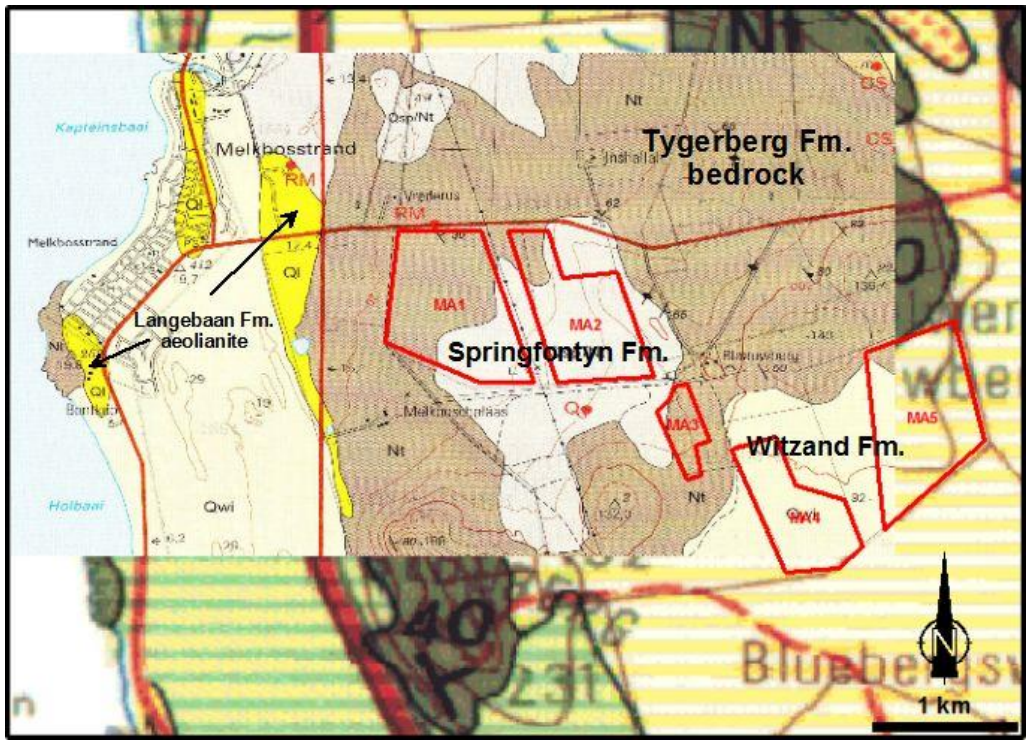


Figure 3. Previous figure with extract from 1:50 000 Geological Map 3318CB Melkbosstrand superimposed.

An updated map of the geology of the area (Figure 3) differs from the earlier, small-scale 1:250000 geological map. It shows a much greater extent of the bedrock (Tygerberg Fm.) and a correspondingly more limited extent of the Springfontyn Formation. This reflects the recognition that the Springfontyn sands are quite thin and the greater thicknesses are banked against the lower flanks of hillsides. Furthermore, the area underlying MA4 and MA5 has been reclassified as the Witzand Formation (Figure 3), reflecting the recent encroachment of white sands from the south. The latter are likely to be underlain by older, pedogenic Springfontyn Formation sands.

The altered and usually structureless nature render these deposits problematic and it is feasible that they comprise units of varying origins and ages. This has led to different interpretations of what constitutes the formation (Pether *et al*., 2000; Roberts *et al*., 2006). In parts, they may be of similar ages as parts of the Langebaan "Limestone" Fm., but derived from less calcareous sources and/or deposited in settings more prone to subsequent groundwater leaching in water tables. The reworking of older coastal-plain deposits was likely the major sediment source in certain areas. Modes of deposition mainly involve windblown sand sheets and dunes, with local swamps/marshes and colluvial/slopewash inputs near topography.

Chase & Thomas (2007) have cored coversands in a regional survey of various settings along the West Coast and applied optically stimulated luminescence (OSL) dating techniques to establish the timing of sand accumulation. Their results indicate several periods of deposition during the

last 100 ka, with activity/deposition at 63–73, 43–49, 30–33, 16–24 and 4–5 ka (the latter being Witzand Fm.). Notably, underlying sands produced dates from ~150 to ~600 ka, reflecting the accumulation of older parts of the Springfontyn Formation equivalents in the middle Quaternary.

3 EXPECTED PALAEONTOLOGY

Fossil bones of terrestrial mammals have been found in the Springfontyn Formation and suggest a middle Quaternary age (Hendey, quoted in Rogers, 1980). Lignified and "coalified" plants, tree stumps and logs have been found at several places in the Springfontyn Formation and are the most common fossil remains encountered (Theron, 1984). However, some of the occurrences of thick peats and clays mentioned in the literature may in fact relate to the much older, underlying Elandsfontyn Formation (Miocene).

The investigation of the thickness of sand in the mining areas by trial pitting (Lanz, 2011) shows that it is usually less than ~3 m, but this is exceeded locally by higher dune forms. A slightly-darker topsoil A horizon, 20-40 cm thick and containing higher organic matter, is underlain by white, yellow or sometimes brown sands. This is suggestive of sand sheets of different ages. Palaeosurfaces/palaeosols separate different coversand units, upon which sparse scatters of fossil bone or artefacts are sometimes found.

The Springfontyn Formation may be underlain by marine deposits such as residual basal gravels with shark teeth, the teeth and bones of cetaceans and the teeth and worn bone fragments of terrestrial mammals that were eroded from older deposits during the marine transgression. However, it is probable that most of these deposits have been flushed off the higher slopes. There is some possibility of encountering residual marine deposits below ~50 m asl. in areas MA1 and MA2.

4 RECOMMENDATIONS

There is a low probability of terrestrial fossil bones being turned up in the mining excavations. Stone Age artefacts may be found buried in the upper part of excavations. With depth, it is possible that fossil plant and wood material could be found. It is important to obtain samples of this material. Residual marine deposits may overlie the weathered bedrock. The likelihood of fossil shell being preserved is low, but petrified, rolled bone fossils are quite common.

In view of the low fossil potential it is proposed that only a basic degree of mitigation is required.

It is recommended that an alert for the uncovering of fossil bone, archaeological implements and fossil plant/peaty material, be included in the Mining EMP.

Appendices 1 and 2 outline monitoring by construction personnel and general Fossil Find Procedures. This is a general guideline, to be adapted to circumstances.

In the event of possible fossil and/or archaeological finds, the contracted archaeologist or palaeontologist must be contacted. For possible fossil finds, the palaeontologist will assess the information and liaise with the developer and the ECO and a suitable response will be established.

Alternates

Iziko Museums of Cape Town: SA Museum, 021 481 3800.

- Dr Graham Avery. 021 481 3895, 083 441 0028.

West Coast Fossil Park

- Pippa Haarhoff: 083 289 6902, 022 766 1606, pippah@iafrica.com

Heritage Western Cape

- Justin Bradfield. 021 483 9543
- Jenna Lavin: 021 483 9685

5 APPLICATION FOR A PALAEONTOLOGICAL PERMIT

A permit from Heritage Western Cape (HWC) is required to excavate fossils. The applicant should be the qualified specialist responsible for assessment, collection and reporting (palaeontologist).

Should fossils be found that require rapid collecting, application for a palaeontological permit will be made to HWC immediately.

The application requires details of the registered owners of the sites, their permission and a site-plan map.

All samples of fossils must be deposited at a SAHRA-approved institution.

6 REPORTING

Should fossils be found a detailed report on the occurrence/s must be submitted. This report is in the public domain and copies of the report must be deposited at the IZIKO S.A. Museum and Heritage Resources Western Cape. It must fulfil the reporting standards and data requirements of these bodies.

The report will be in standard scientific format, basically:

- A summary/abstract.
- Introduction.
- Previous work/context.
- Observations (incl. graphic sections, images).
- Palaeontology.
- Interpretation.
- Concluding summary.
- References.
- Appendices

The draft report will be reviewed by the client, or externally, before submission of the Final Report.

7 REFERENCES

Chase, B.M., Thomas, D.S.G. 2007. Multiphase late Quaternary aeolian sediment accumulation in western South Africa: timing and relationship to palaeoclimatic changes inferred from the marine record. *Quaternary International* **166**: 29–41.

Lanz, J. 2011. Assessment of the impact of sand mining on the agricultural potential of parts of the farm Blaauwberg. Report for AMATHEMBA Environmental Management Consulting & Tip Trans Resources (Pty) Ltd.

Pether, J, Roberts, D.L. and Ward, J.D. 2000. Deposits of the West Coast (Chapter 3). In: Partridge, T.C. and Maud, R.R. eds. The Cenozoic of Southern Africa*. Oxford Monographs on Geology and Geophysics No. 40. Oxford University Press*: 33-55.

Roberts, D.L., Botha, G.A., Maud, R.R. & Pether, J. 2006. Coastal Cenozoic Deposits. In: Johnson, M. R., Anhaeusser, C. R. and Thomas, R. J. (eds.), *The Geology of South Africa*. Geological Society of South Africa, Johannesburg/Council for Geoscience, Pretoria. 605-628.

Rogers, J. 1980. First report on the Cenozoic sediments between Cape Town and Eland's Bay. *Geological Survey of South Africa Open File* **136**.

Rogers, J. 1983. Lithostratigraphy of Cenozoic sediments on the coastal plain between Cape Town and Saldanha Bay. *Technical Report of the Joint Geological Survey/University of Cape Town Marine Geoscience Unit* **14**: 87-103.

Theron, J.N. 1984. The geology of Cape Town and environs. *Explanation of 1:50 000 sheets 3318CD & DC, 3418 AB, AD &BA. 77 pp. Council for Geoscience, Pretoria.*

Visser, H.N. & Schoch, A.E. 1972. Map Sheet 255: 3217D & 3218C (St Helenabaai), 3317B & 3318A (Saldanhabaai*)*. *Geological Survey of South Africa*.

Visser, H.N. and Schoch, A.E. 1973. The geology and mineral resources of the Saldanha Bay area. *Memoir Geological Society of South Africa* **63**.

8 GLOSSARY

~ (tilde): Used herein as “approximately” or “about”.

Aeolian: Pertaining to the wind. Refers to erosion, transport and deposition of sedimentary particles by wind. A rock formed by the solidification of aeolian sediments is an aeolianite.

AIA: Archaeological Impact Assessment.

Alluvium: Sediments deposited by a river or other running water.

Archaeology: Remains resulting from human activity which are in a state of disuse and are in or on land and which are older than 100 years, including artefacts, human and hominid remains and artificial features and structures.

asl.: above (mean) sea level.

Bedrock: Hard rock formations underlying much younger sedimentary deposits.

Calcareous: sediment, sedimentary rock, or soil type which is formed from or contains a high proportion of calcium carbonate in the form of calcite or aragonite.

Calcrete: An indurated deposit (duricrust) mainly consisting of Ca and Mg carbonates. The term includes both pedogenic types formed in the near-surface soil context and non-pedogenic or groundwater calcretes related to water tables at depth.

Clast: Fragments of pre-existing rocks, *e.g*. sand grains, pebbles, boulders, produced by weathering and erosion. Clastic – composed of clasts.

Colluvium: Hillwash deposits formed by gravity transport downhill. Includes soil creep, sheetwash, small-scale rainfall rivulets and gullying, slumping and sliding processes that move and deposit material towards the foot of the slopes.

Coversands: Aeolian blanket deposits of sandsheets and dunes.

Duricrust: A general term for a zone of chemical precipitation and hardening formed at or near the surface of sedimentary bodies through pedogenic and (or) non-pedogenic processes. It is formed by the accumulation of soluble minerals deposited by mineral-bearing waters that move upward, downward, or laterally by capillary action, commonly assisted in arid settings by evaporation. Classified into calcrete, ferricrete, silcrete.

ECO: Environmental Control Officer.

EIA: Impact Assessment.

EMP: Environmental Management Plan.

ESA: Early Stone Age. The archaeology of the Stone Age between 2 000 000 and 250 000 years ago.

Ferricrete: Indurated deposit (duricrust) consisting predominantly of accumulations of iron sesquioxides, with various dark-brown to yellow-brown hues. It may form by deposition from solution or as a residue

after removal of silica and alkalis. Like calcrete it has pedogenic and groundwater forms. Synonyms are laterite, iron pan or “koffieklip”.

Fluvial deposits: Sedimentary deposits consisting of material transported by, suspended in and laid down by a river or stream.

Fm.: Formation.

Fossil: Mineralised bones of animals, shellfish, plants and marine animals. A trace fossil is the track or footprint of a fossil animal that is preserved in stone or consolidated sediment.

Heritage: That which is inherited and forms part of the National Estate (Historical places, objects, fossils as defined by the National Heritage Resources Act 25 of 1999).

HIA: Heritage Impact Assessment.

LSA: Late Stone Age. The archaeology of the last 20 000 years associated with fully modern people.

LIG: Last Interglacial. Warm period 128-118 ka BP. Relative sea-levels higher than present by 4-6 m. Also referred to as Marine Isotope Stage 5e or “the Eemian”.

Midden: A pile of debris, normally shellfish and bone that have accumulated as a result of human activity.

MSA: Middle Stone Age. The archaeology of the Stone Age between 20-300 000 years ago associated with early modern humans.

OSL: Optically stimulated luminescence. One of the radiation exposure dating methods based on the measurement of trapped electronic charges that accumulate in crystalline materials as a result of low-level natural radioactivity from U, Th and K. In OSL dating of aeolian quartz and feldspar sand grains, the trapped charges are zeroed by exposure to daylight at the time of deposition. Once buried, the charges accumulate and the total radiation exposure (total dose) received by the sample is estimated by laboratory measurements. The level of radioactivity (annual doses) to which the sample grains have been exposed is measured in the field or from the separated minerals containing radioactive elements in the sample. Ages are obtained as the ratio of total dose to annual dose, where the annual dose is assumed to have been similar in the past.

Palaeontology: The study of any fossilised remains or fossil traces of animals or plants which lived in the geological past and any site which contains such fossilised remains or traces.

Palaeosol: An ancient, buried soil whose composition may reflect a climate significantly different from the climate now prevalent in the area where the soil is found. Burial reflects the subsequent environmental change.

Palaeosurface: An ancient land surface, usually buried and marked by a palaeosol or pedocrete, but may be exhumed by erosion (*e.g*. wind erosion/deflation) or by bulk earth works.

Peat: partially decomposed mass of semi-carbonized vegetation which has grown under waterlogged, anaerobic conditions, usually in bogs or swamps.

Pedogenesis/pedogenic: The process of turning sediment into soil by chemical weathering and the activity of organisms (plants growing in it, burrowing animals such as worms, the addition of humus *etc.*).

Pedocrete: A duricrust formed by pedogenic processes.

PIA: Palaeontological Impact Assessment.

SAHRA: South African Heritage Resources Agency – the compliance authority, which protects national heritage.

Stone Age: The earliest technological period in human culture when tools were made of stone, wood, bone or horn. Metal was unknown.

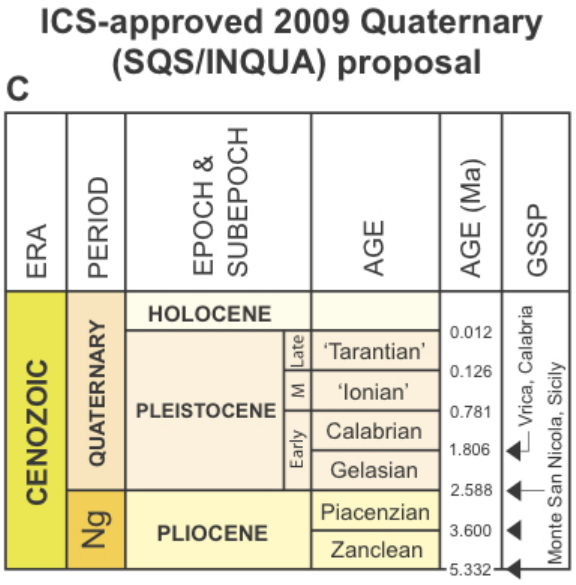
8.1 GEOLOGICAL TIME SCALE TERMS (YOUNGEST TO OLDEST).

ka: Thousand years or kilo-annum (10^3 years). Implicitly means "ka ago" *i.e*. duration from the present, but "ago" is omitted. The "Present" refers to 1950 AD. Generally not used for durations not extending from the Present. Sometimes "kyr" is used instead.

Ma: Millions years, mega-annum (10^6 years). Implicitly means "Ma ago" *i.e.* duration from the present, but "ago" is omitted. The "Present" refers to 1950 AD. Generally not used for durations not extending from the Present.

Holocene: The most recent geological epoch commencing 11.7 ka till the present.

Pleistocene: Epoch from 2.6 Ma to 11.7 ka. Late Pleistocene 11.7–126 ka. Middle Pleistocene 135–781 ka. Early Pleistocene 781–2588 ka (0.78-2.6.Ma).



Quaternary: The current Period, from 2.6 Ma to the present, in the Cenozoic Era. The Quaternary includes both the Pleistocene and Holocene epochs. The terms early, middle or late in reference to the Quaternary should only be used with lower case letters because these divisions are

informal and have no status as divisions of the term Quaternary. The sub-divisions 'Early', 'Middle' or 'Late' apply only to the word Pleistocene. As used herein, early and middle Quaternary correspond with the Pleistocene divisions, but late Quaternary includes the Late Pleistocene and the Holocene.

Pliocene: Epoch from 5.3-2.6 Ma.

Miocene: Epoch from 23-5 Ma.

---oooOOOooo---

9 APPENDIX 1 – MONITORING FOR FOSSILS

A regular monitoring presence over the period during which excavations are made, by either an archaeologist or palaeontologist, is generally not practical.

The field supervisor/foreman and workers involved in digging excavations must be encouraged and informed of the need to watch for potential fossil and buried archaeological material. Workers seeing potential objects are to report to the field supervisor who, in turn, will report to the ECO. The ECO will inform the archaeologist and/or palaeontologist contracted to be on standby in the case of fossil finds.

To this end, responsible persons must be designated. This will include hierarchically:

- The field supervisor/foreman, who is going to be most often in the field.
- The Environmental Control Officer (ECO) for the project.
- The Project Manager.

Should the monitoring of the excavations be a stipulation in the Archaeological Impact Assessment, the contracted Monitoring Archaeologist (MA) can also monitor for the presence of fossils and make a field assessment of any material brought to attention. The MA is usually sufficiently informed to identify fossil material and this avoids additional monitoring by a palaeontologist. In shallow coastal excavations, the fossils encountered are usually in an archaeological context.

The MA then becomes the responsible field person and fulfils the role of liaison with the palaeontologist and coordinates with the developer and the Environmental Control Officer (ECO). If fossils are exposed in non-archaeological contexts, the palaeontologist should be summoned to document and sample/collect them.

---oooOOOooo---

10 APPENDIX 2 - FOSSIL FIND PROCEDURES

In the context under consideration, it is improbable that fossil finds will require declarations of permanent “no go” zones. At most a temporary pause in activity at a limited locale may be required. The strategy is to rescue the material as quickly as possible.

The procedures suggested below are in general terms, to be adapted as befits a context. They are couched in terms of finds of fossil bones that usually occur sparsely, such as in the aeolian deposits. However, they may also serve as a guideline for other fossil material that may occur.

In contrast, fossil shell layers are usually fairly extensive and can be easily documented and sampled.

Bone finds can be classified as two types: isolated bone finds and bone cluster finds.

10.1 ISOLATED BONE FINDS

In the process of digging the excavations, isolated bones may be spotted in the hole sides or bottom, or as they appear on the spoil heap. By this is meant bones that occur singly, in different parts of the excavation. If the number of distinct bones exceeds 6 pieces, the finds must be treated as a bone cluster (below).

Response by personnel in the event of isolated bone finds

- **Action 1:** An isolated bone exposed in an excavation or spoil heap must be retrieved before it is covered by further spoil from the excavation and set aside.
- **Action 2:** The site foreman and ECO must be informed.
- **Action 3:** The responsible field person (site foreman or ECO) must take custody of the fossil. The following information to be recorded:
    - Position (excavation position).
    - Depth of find in hole.
    - Digital image of hole showing vertical section (side).
    - Digital image of fossil.
- **Action 4:** The fossil should be placed in a bag (*e.g.* a Ziplock bag), along with any detached fragments. A label must be included with the date of the find, position info., depth.
- **Action 5:** ECO to inform the developer, the developer contacts the standby archaeologist and/or palaeontologist. ECO to describe the occurrence and provide images asap. by email.

Response by Palaeontologist in the event of isolated bone finds

The palaeontologist will assess the information and liaise with the developer and the ECO and a suitable response will be established.

10.2 BONE CLUSTER FINDS

A bone cluster is a major find of bones, *i.e*. several bones in close proximity or bones resembling part of a skeleton. These bones will likely be seen in broken sections of the sides of the hole and as bones appearing in the bottom of the hole and on the spoil heap.

Response by personnel in the event of a bone cluster find

- **Action 1:** Immediately stop excavation in the vicinity of the potential material. Mark (flag) the position and also spoil that may contain fossils.
- **Action 2:** Inform the site foreman and the ECO.
- **Action 3:** ECO to inform the developer, the developer contacts the standby archaeologist and/or palaeontologist. ECO to describe the occurrence and provide images asap. by email.

Response by Palaeontologist in the event of a bone cluster find
The palaeontologist will assess the information and liaise with the developer and the ECO and a suitable response will be established. It is likely that a Field Assessment by the palaeontologist will be carried out asap.

It will probably be feasible to "leapfrog" the find and continue the excavation farther along, or proceed to the next excavation, so that the work schedule is minimally disrupted. The response time/scheduling of the Field Assessment is to be decided in consultation with developer/owner and the environmental consultant.

The field assessment could have the following outcomes:

- If a human burial, the appropriate authority is to be contacted (see AIA). The find must be evaluated by a human burial specialist to decide if Rescue Excavation is feasible, or if it is a Major Find.
- If the fossils are in an archaeological context, an archaeologist must be contacted to evaluate the site and decide if Rescue Excavation is feasible, or if it is a Major Find.
- If the fossils are in an palaeontological context, the palaeontologist must evaluate the site and decide if Rescue Excavation is feasible, or if it is a Major Find.

10.3 RESCUE EXCAVATION

Rescue Excavation refers to the removal of the material from the just the "design" excavation. This would apply if the amount or significance of the exposed material appears to be relatively circumscribed and it is feasible to remove it without compromising contextual data. The time span for Rescue Excavation should be reasonably rapid to avoid any or undue delays, *e.g*. 1-3 days and definitely less than 1 week.

In principle, the strategy during mitigation is to "rescue" the fossil material as quickly as possible. The strategy to be adopted depends on the nature of the occurrence, particularly the density of the fossils. The methods of collection would depend on the preservation or fragility of the fossils and whether in loose or in lithified sediment. These could include:

- On-site selection and sieving in the case of robust material in sand.
- Fragile material in loose/crumbly sediment would be encased in blocks using Plaster-of Paris or reinforced mortar.

If the fossil occurrence is dense and is assessed to be a “Major Find”, then carefully controlled excavation is required.

10.4 MAJOR FINDS

A Major Find is the occurrence of material that, by virtue of quantity, importance and time constraints, cannot be feasibly rescued without compromise of detailed material recovery and contextual observations.
A Major Find is not expected.

Management Options for Major Finds
In consultation with developer/owner and the environmental consultant, the following options should be considered when deciding on how to proceed in the event of a Major Find.

Option 1: Avoidance

Avoidance of the major find through project redesign or relocation. This ensures minimal impact to the site and is the preferred option from a heritage resource management perspective. When feasible, it can also be the least expensive option from a construction perspective.

The find site will require site protection measures, such as erecting fencing or barricades. Alternatively, the exposed finds can be stabilized and the site refilled or capped. The latter is preferred if excavation of the find will be delayed substantially or indefinitely. Appropriate protection measures should be identified on a site-specific basis and in wider consultation with the heritage and scientific communities.

This option is preferred as it will allow the later excavation of the finds with due scientific care and diligence.

Option 2: Emergency Excavation

Emergency excavation refers to the “no option” situation wherein avoidance is not feasible due to design, financial and time constraints. It can delay construction and emergency excavation itself will take place under tight time constraints, with the potential for irrevocable compromise of scientific quality. It could involve the removal of a large, disturbed sample by excavator and conveying this by truck from the immediate site to a suitable place for “stockpiling”. This material could then be processed later.

Consequently, emergency excavation is not a preferred option for a Major Find.

10.5 Exposure of Fossil Shell Beds

Response by personnel in the event of intersection of fossil shell beds

- **Action 1:** The site foreman and ECO must be informed.

- **Action 2:** The responsible field person (site foreman or ECO) must record the following information:
    - Position (excavation position).
    - Depth of find in hole.
    - Digital image of hole showing vertical section (side).
    - Digital images of the fossiliferous material.
- **Action 3:** A generous quantity of the excavated material containing the fossils should be stockpiled near the site, for later examination and sampling.
- **Action 4:** ECO to inform the developer, the developer contacts the standby archaeologist and/or palaeontologist. ECO to describe the occurrence and provide images asap. by email.

Response by Palaeontologist in the event of fossil shell bed finds
The palaeontologist will assess the information and liaise with the developer and the ECO and a suitable response will be established. This will most likely be a site visit to document and sample the exposure in detail, before it is covered up.

10.6 Exposure of Fossil Wood and Peats

As for 10.5 above.

---oooOOOooo---